

**CLAIM LISTING**

1. (Original) A method for producing multiple quantum well intermixed (QWI) regions having different bandgaps on a single substrate, comprising the steps of:
  - a) patterning the surface of the substrate with QWI-initiating material in first regions of the surface;
  - b) conducting a first thermal processing cycle on the substrate to generate a first bandgap shift in the first regions;
  - c) patterning the surface of the substrate with QWI-initiating material in second regions of the surface, distinct from said first regions; and
  - d) conducting a second thermal processing cycle on the substrate to generate a second bandgap shift in the second regions, and to generate a cumulative bandgap shift in the first regions, the cumulative bandgap shift being the cumulative result of said first and second thermal processing cycles.
2. (Previously presented) The method of claim 1 further including the steps of:
  - e) patterning the surface of the substrate with QWI-initiating material in third regions of the surface, distinct from said first regions and said second regions; and
  - f) conducting a third thermal processing cycle on the substrate to: (i) generate a third bandgap shift in the third regions, (ii) generate a cumulative bandgap shift in the second regions, the cumulative bandgap shift in the second regions being the cumulative result of the second and third thermal processing cycles; and (iii) generate a further cumulative bandgap shift in the first regions, the cumulative bandgap shift in the first regions being the cumulative result of the first, second and third thermal processing cycles.
3. (Previously presented) The method of claim 2 further including the steps of:
  - g) patterning the surface of the substrate with QWI-initiating material in other

regions of the surface, distinct from all regions of the surface previously covered with QWI-initiating material; and

h) conducting a subsequent thermal processing cycle to generate a bandgap shift in the other regions, and to generate cumulative bandgap shifts in all regions previously covered with QWI-initiating material prior to the most recent patterning step, the cumulative bandgap shifts each being the cumulative result of all thermal processing cycles to which the respective region has been exposed since being first covered with the QWI-initiating material.

4. (Previously presented) The method of claim 1 further including the step of covering adjacent regions of the substrate not covered with QWI-initiating material with QWI-inhibiting material.

5. (Previously presented) The method of claim 1 in which at least one of the thermal processing cycles comprises a rapid thermal anneal cycle.

6. (Original) The method of claim 5 in which all of the thermal processing cycles comprise rapid thermal anneal cycles.

7. (Previously presented) The method of claim 1 in which the steps of patterning regions of the substrate with QWI-initiating material comprises the steps of:

depositing photoresist on the substrate;

forming windows in the photoresist coextensive with the region of the substrate to be covered with QWI-initiating material;

depositing the QWI-initiating material onto the substrate; and

lifting the photoresist off the substrate.

8. (Previously presented) The method of claim 1 in which the QWI-

initiating material comprises an impurity rich material.

9. (Original) The method of claim 8 in which the impurity comprises one or more of sulphur, zinc, silicon, fluorine, copper, germanium, tin and selenium.

10. (Previously presented) The method of claim 8 in which the impurity-rich material comprises silica doped with one or more of the impurities sulphur, zinc, silicon, fluorine, copper, germanium, tin and selenium.

11. (Previously presented) The method of claim 1 in which the QWI-initiating material is sputter deposited.

12. (Original) The method of claim 4 in which the QWI-inhibiting material comprises a PECVD-silica layer.

13. (Previously presented) The method of claim 1 in which the QWI-initiating material from a given region is removed from the substrate after the first thermal processing cycle to which it is exposed and prior to a subsequent thermal processing cycle.

14. (Previously presented) The method of claim 1 in which the QWI-initiating material on a given region is retained on the substrate for subsequent thermal processing cycles.

15. (Original) The method of claim 14 in which the QWI-initiating material on a given region is retained on the substrate for all subsequent thermal processing cycles.

16. (Previously presented) The method of claim 1 used on an InP/AlInGaAs substrate.

17. (Previously presented) The method of claim 1 in which each of the thermal processing cycles is performed for substantially the same length of time.
18. (Original) The method of claim 17 in which each of the thermal processing cycles is performed at different temperatures.
19. (Canceled).
20. (Currently amended) The method of ~~claim 24~~~~claim 19~~, further comprising the steps of:
  - (i) establishing thermal processing conditions  $A_N$  suitable for obtaining the smallest cumulative bandgap shift  $BG_1$  of the Nth region;
  - (ii) performing a thermal processing cycle on a first sample using  $A_N$  to obtain bandgap shift  $BG_1$ ;
  - (iii) establishing thermal processing conditions  $A_{N-1}$  suitable for obtaining the cumulative bandgap shift  $BG_2$  of the N-lth region;
  - (iv) performing a thermal processing cycle on said first sample, after step (ii), using  $A_{N-1}$  to obtain bandgap shift  $BG_2$ ;
  - (v) performing thermal processing cycles  $A_{N-1}$  then  $A_N$  on a second sample to obtain bandgap shift  $BG_2'$ ;
  - (vi) establishing whether the anneal process is symmetric, i.e., if  $BG_2 = BG_2'$ , and if so performing steps (vii) to (viii), otherwise performing step (ix);
  - (vii) establishing thermal processing conditions  $A_{N-2}$  suitable for obtaining the cumulative bandgap shift  $BG_3$ ;
  - (viii) performing a thermal processing cycle on said first sample, after step (iv), using  $A_{N-2}$  to obtain bandgap shift  $BG_3$ ;
  - (ix) establishing cumulative thermal processing cycles  $A_1$  to  $A_N$  for each one of the cumulative bandgap shifts  $BG_N$  to  $BG_1$  on separate samples for each one of the

cumulative bandgap shifts required.

21. – 23. (Canceled).

24. (New) The method of claim 1, wherein the thermal processing cycles  $A_n$  are ones of a plurality of thermal processing cycles  $A_1-A_n$  and wherein the cumulative bandgap shift  $BG_n$  is one of a plurality of cumulative bandgap shifts  $BG_1- BG_N$ , the method further comprising the steps of:

prior to said step of patterning the surface of the substrate with QWI-initiating material in first regions of the surface, determining whether the process for generating cumulative bandgap shifts resulting from successive thermal processing cycles is symmetric or asymmetric;

if the process is symmetric, determining thermal process conditions required for each one of the plurality of cumulative bandgap shifts  $BG_1$  to  $BG_N$  by successively thermally processing at least one sample through the thermal process sequence  $A_N$  to  $A_1$ , where  $A_1$  is the thermal process required to obtain  $BG_N$  from  $BG_{N-1}$ ;  $A_2$  is the thermal process required to obtain  $BG_{N-1}$  from  $BG_{N-2}$ ; etc.; through to  $A_N$  being the thermal process required to obtain  $BG_1$  from  $BG_0$ ; and

if the process is asymmetric, determining the thermal process conditions required for each one of the plurality of cumulative bandgap shifts  $BG_1$  to  $BG_N$  by partially or completely thermally processing a plurality of samples through a sequence in the order  $A_1$  to  $A_N$  for each one of the bandgap shifts required.